UNIVERSITI PUTRA MALAYSIA

TREE SPECIES COMPOSITION AND DISTRIBUTION IN AYER HITAM FOREST RESERVE, PUCHONG, SELANGOR

PHILIP LEPUN

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By

PHILIP LEPUN

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia in Fulfilment of the Requirements for the Degree of Master of Science

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Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirements for the degree of Master of Science

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Chairman: **Associate Professor Faridah Hanum Ibrahim, Ph.D.**

Faculty: **Forestry**

The study was conducted in Ayer Hitam Forest Reserve (AHFR), Puchong, Selangor to assess the floristic composition, stand attributes (including basal area, stem density, volume, above-ground biomass) and the tree species distribution. Besides that, the study aims to recognize the conservation status of tree species, potential increment of the species within the sampling area and it regenerating level by using the summation method.

The enumeration of trees ≥5 cm dbh in the 5-ha plot recorded 6,621 trees which belong to 50 families, 148 genera and 319 species. Euphorbiaceae in this plot was found dominant in genera and tree stems but Myristicaceae has the most number of species with 27 species. *Agrostistachys longifolia* var. *longifolia* recorded 7.0% of all trees was the highest in stem number.

Shannon-Weiner diversity index, H' of the area was calculated at 4.74. In this study, 4.4% of the endemic species for Peninsular Malaysia and 9.4% of the tree species was recorded for the first time for the state of Selangor. Only *Artocarpus lowii* was identified as uncommon and *Canarium sumatranum* is a rare species occurring in this area.

Ayer Hitam Forest Reserve stratification and the stand density could be divided into five classes. The secondary species found occurring in this plot was 4.1% of the tree species. The total basal area, volume and above-ground biomass of the trees in 5-ha plot was 161.7 m^2, 6,316.5 m^3 and 1,777.2 t respectively. Every addition of a hectare in the contiguous area in the AHFR shows that there is an increase accumulative number of species with the ranges of 9–35 species.

The distribution of the tree species in the plot study was found to be influenced by the soil type, topography, mother tree and the logging activities in two types of distributions—random and clumped. Analysis using General Linear Models (GLM) procedure showed significant differences at level $p<0.05$ between blocks in terms of volume, basal area and biomass and dbh and height for sub-blocks.

In conclusion, this study supported the classification of AHFR, Puchong as a "Kelat-Kedondong-Mixed Dipterocarp" forest which also shows the richness of this forest in terms of species, stand density and the distribution of tree species of a late stage regeneration.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

KOMPOSISI DAN TABURAN SPESIS POKOK DI HUTAN SIMPAN AYER HITAM, PUCHONG, SELANGOR.

Oleh

PHILIP LEPUN

April 2002

Pengerusi: **Profesor Madya Faridah Hanum Ibrahim, Ph.D.**

Fakulti: **Perhutanan**

Kajian ini telah dilakukan di Hutan Simpan Ayer Hitam (HSAH), Puchong, Selangor untuk mengenal pasti komposisi flora, sifat dirian (yang meliputi luas pangkal, kepadatan pokok, isipadu, biomes di atas paras tanah) dan taburan spesies pokok. Di samping itu, kajian ini berusaha untuk mengenali status pemuliharaan bagi semua spesies pokok, potensi peningkatan spesies dengan peningkatan luas kawasan dan tahap regenerasi hutan tersebut menggunakan kaedah penjumlahan.

Keputusan bancian bagi pokok yang mempunyai diameter ≥5 cm pada paras dada dalam plot 5-ha mencatat jumlah sebanyak 6,621 pokok yang dipunyai 50 famili, 148 genera and 319 spesies. Euphorbiaceae dalam kawasan ini dijumpai dominan dari segi genus dan bilangan pokok tetapi Myristicaceae didapati mencatatkan bilangan spesies yang terbanyak dengan 27 spesies.

Agrostistachys longifolia var. *longifolia* mencatatkan 466 pokok 7.0% daripada bilangan pokok yang merupakan bilangan pokok yang tertinggi.

Indeks kepelbagaian spesies Shannon-Weiner, H' yang dikira ialah pada 4.74. Dalam kajian ini, 4.4% adalah endemik spesies bagi Semenanjung Malaysia dan 9.4% daripada jumlah spesies merupakan pertama kali direkodkan bagi Negeri Selangor. Hanya *Artocarpus lowii* dikenalpasti sebagai tidak biasa dijumpai dan *Canarium sumatranum* pula sebagai spesies jarang yang dijumpai terdapat di kawasan ini.

Hutan Simpan Ayer Hitam mempunyai susun lapis dan kepadatan dirian yang boleh dibahagikan kepada lima kelas. Spesies sekunder yang dijumpai terdapat dalam plot ini ialah 4.1% daripada spesies pokok. Jumlah luas pangkal, isipadu dan biomes di atas paras tanah bagi pokok dalam 5-ha plot ialah 161.7 m^2, 6,316.5 m^3 dan 1,777.2 t. Bagi setiap hektar pertambahan kawasan yang berturutan di HSAH jelas menunjukkan terdapat peningkatan bagi angka timbunan spesies dalam kajian dengan julat antara 9–35 spesies.

Taburan pokok dalam kawasan ini didapati banyak dipengaruhi oleh jenis tanah, topografi, induk pokok dan aktiviti pembalakan sebelum ini dalam dua jenis taburan—rawak dan berkelompok. Analisis menggunakan kaedah "General Linear Models" (GLM) menunjukkan terdapat perbezaan yang nyata pada paras $p<0.05$ di antara blok dari segi isipadu, luas pangkal dan biomes dan dbh and ketinggian bagi sub-blok.

Pada kesimpulannya, kajian ini juga dapat menyokong bahawa HSAH, Puchong sebagai hutan "Kelat-Kedondong-Dipterocarp Campuran" yang mana juga menunjukkan kekayaan hutan ini dari segi spesies, kepadatan dirian dan taburan spesies pokok bagi hutan yang dalam peringkat regenerasi akhir.

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Special thanks to my wife Ribka Alan and my parents, brothers and sisters for their constant love, guidance and encouragement for this success and the great source of inspiration.

I certify that an Examination Committee met on 26th April 2002 to conduct the final examination of Philip Lepun on his Master of Science thesis entitled "Tree Species Composition and Distribution in Ayer Hitam Forest Reserve, Puchong, Selangor" in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulation 1981. The Committee recommends that the candidate be awarded the relevant degree. Members of the Examination Committee are as follows:

MOHD. ZAKI HAMZAH, Ph.D
Lecturer
Faculty of Forestry
Universiti Putra Malaysia
(Chairman)

FARIDAH HANUM IBRAHIM, Ph.D.
Associate Professor
Faculty of Forestry
Universiti Putra Malaysia
(Member)

MOHAMAD AZANI ALIAS, Ph.D.
Lecturer
Faculty of Forestry
Universiti Putra Malaysia
(Member)

KAMZIAH BT ABD KUDUS
Lecturer
Faculty of Forestry
Universiti Putra Malaysia
(Member)

SHAMSHER MOHAMAD RAMADILI, Ph.D.
Professor/Deputy Dean
School of Graduate Studies,
Universiti Putra Malaysia

Date: 06 MAY 2002

This thesis was submitted of the Senate of Universiti Putra Malaysia and was accepted as fulfilment of the requirements for the degree of Master of Science.

AINI IDERIS, Ph.D.
Professor/Dean
School of Graduate Studies,
Universiti Putra Malaysia.

Date : 13 JUN 2002

DECLARATION

I hereby declare that the thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at UPM or other institutions.

(PHILIP LEPUN)

Date:

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LIST OF ABBREVIATIONS

AHFR	Ayer Hitam Forest Reserve
a.s.l	Above sea level
BA	Basal Area
Bt	Bukit (Hill)
C	Celsius
DBH	Diameter Breast Height
DOE	Dissolved Oxygen Electrical
E	East
FRIM	Forest Research Institute of Malaysia
ft	Feet
Gg	Gunung (Mount)
H	Height
ha	Hectare
Jh	Johor
KEP	Kepong
Kd	Kedah
kJ	Kilojoules
kg	Kilogram
Kl	Kelantan
Ph	Pahang
Pk	Perak
Pn	Penang (Pulau Pinang)
MARDI	Malaysia Agriculture Research Development Institute
Max	Maximum
Min	Minimum
Ml	Malacca (Melaka)
mm	Millimeter
MOSTE	Ministry of Science, Technology and Environment Malaysia
m^2	Meter square
m^3	Meter cube
m/s	Meter per second
N	North
No.	Number
NS	Negeri Sembilan
P	Pulau (Island)
PFR	Permanent Forest Reserve
PORIM	Palm Oil Research Institute of Malaysia
Ps	Perlis
RRIM	Rubber Research Institute of Malaysia
S	South
Sg.	Sungai (Stream)
Sl	Selangor
SMS	Selective Management System
Sp	Singapore (Singapura)
SPDVER	Species Diversity

sq.	Square
t	Tonne
Tg	Trengganu (Terengganu)
TRF	Tropical Rain Forest
t/ha	Tonne/hectare
UKMB	Universiti Kebangsaan Malaysia Bangi
UPM	Universiti Putra Malaysia
Vol	Volume
Vs	Versus
W	West
WB	Weight of Branch
WL	Weight of Leaves
WQI	Water Quality Index
WS	Weight of Stem
yr	Year

CHAPTER I

INTRODUCTION

General Introduction

The Ayer Hitam Forest Reserve (AHFR), Puchong was much larger, covering an area of about 3,500 hectares prior to its lease to Universiti Putra Malaysia (UPM) in 1996. This forest is located in the state of Selangor in Peninsular Malaysia. The size of this forest is now 1,248 hectares after it was further excised for some socio-economic development projects such as housing estates, oil palm plantations, new townships, factories and highways. The Selangor State Government on 7th October 1996 awarded this forest with six compartments (1, 2, 12, 13, 14 and 15) to UPM for 80 years for the purpose of teaching, research and extension activities.

The AHFR is presently surrounded by development, making it an isolated patch of forest in the midst of modern infrastructure and human settlements. Being strategically located within the Government's Multimedia Super Corridor that connects Kuala Lumpur with the new administrative city of Putrajaya and business city of Cyberjaya, it is one of only very few remaining lowland forest patches found in the Klang Valley. This forest is also readily accessible to all kinds of vehicle up to the base camp through the new housing estates of Taman Lestari Puchong, Taman Pinggiran Putra and Taman Perdana Puchong.

This forest is classified as a disturbed Kelat-Kedondong-Mixed Dipterocarp type of lowland forest (Faridah Hanum and Zamri Rosli, 2000) and located between 3°00′00″N and 3°02′20″N and between 101°37′90″E and 101°40′00″E, approximately 20 kilometres south-west of Kuala Lumpur. There are three major streams (Sg. Rasau, Sg. Bohol and Sg. Biring) flowing to the south of this forest which is generally low hilly area. This forest had been selectively logged several times in the past from 1936 to 1965. The technique of logging activities used was crawler tractor and wind-lorry (Irak Sarip, 2000). Even more unique is the use of this forest by a group of indigenous people from the Temuan Tribe, who only recently moved to the edge of the forest at Kampung Sungai Rasau Dalam (with 22 families) and Kampung Sungai Rasau Luar (with 32 families) (Rahim, 1997).

Although this forest is surrounded by rapid socio-economic development, it is ironically a substantial pharmacopoeia for the indigenous population. The diverse medicinal plant species in this forest were recorded and grouped according to seven methods of application, namely, as a drink, eaten, chewed, as poultice, as a rub, used in baths and used as shampoo (Faridah Hanum and Nurulhuda, 1999; Indu and Ng, 2000).

Ayer Hitam Forest Reserve has always been associated with a group of Orang Asli from the Temuan Tribe living at the forest fringe, who relies on it for food, medicines and fruits. According to Rusli Mohd. *et al*. (1997), in terms of species collected, the Orang Asli community was more dependent on the forest for food and fruits more than other purposes such as housing material,

handicrafts and medicines. As many as 24 species of wildlife were hunted for meat, and 10 species of the plant species were used for fruits. The revenue generated by the Orang Asli in collecting the timber and non-timber products amounted to nearly RM110, 000 for the year 1996 (Rahim, 1997).

Ayer Hitam Forest Reserve in the past was well known as a valuable timber resource to the Selangor state government and the community in terms of direct and indirect monetary and non-monetary benefits. Forests also provide a source of food and genetic resources for many agricultural crops, and help in sustaining favourable environmental conditions (Awang Noor Abdul Ghani *et al.,* 1999). In order to fulfill ecotourism needs, the forest area must be able to accommodate recreational requirements that prioritise rewarding experience and educational opportunity within the natural setting. AHFR has all the resources to supply those needs to the public. In addition, a rugged landform, high biodiversity and presence of water bodies make AHFR a suitable area for nature appreciation (Abdullah Mohd. *et al.,* 1999) and a suitable venue for environmental education in the Klang Valley and nearby areas (Ahmad Ismail, 1999).

Statement of Problem and Study Objectives

Ayer Hitam Forest Reserve is the only remaining natural "green lung" for the developing cities of Putrajaya and Cyberjaya. The rapid pace of development surrounding this forest becomes an indirect pressure working against

maintaining the integrity of this forest for its biological diversity and its ecological functions. The development nearby has in fact contributed to the trespass of the forest area and loss of biological diversity. The loss of biodiversity through the impact and effects of extractive uses of the forest, such as logging activities, is complex and depends on the particular features of a forest area and the nature of disturbance.

A lack of information hampers our ability to comprehend the magnitude of richness of the biodiversity, and consequently the loss of this biodiversity. It also prevents measure against further losses, and it is difficult to formulate sustainable alternatives to avoid resource depletion. Before this, there was no substantial research plot established in the AHFR for estimation of its biological diversity. Therefore, the forest's biological diversity needs to be specially studied to ascertain the nature of its composition, including the recognition of rare or potentially endangered taxa in need of special attention. It will be expected that there will be forest species that are not readily identified, so that their conservation status cannot be clearly stated. Without this information, proper systematic management of the AHFR cannot be practised.

Although a major problem that needs to be addressed is the species richness and tree species distribution of the AHFR, and it is recognized that species totals will potentially increase with increasing sampling area. This thesis aims to perform preliminary work that will contribute the following insights:-

1) how species tallies might change when sampling increases from 1 ha plot (as carried out in past studies) to a 5 ha plot (as used in the present study), where this species was distributed and how this might suggest further sampling work in the future;
2) whether physical attributes of the stand (such as basal area, volume, above-ground biomass) and floristic composition, when compared with the results from other studies, would permit reasonable interpretation of the state of regeneration of the logged-over forest represented by the present plot.

The rationale for the intended work in (1) above is that some idea is first required of how species richness increases on site, before being able to accordingly plan sampling strategy to obtain the best approximation of the total species richness of the whole AHFR area. For example, it would be of interest to know within the range of increase from 1 ha to 5 ha, there is already some indication of a decrease in the rate of species accumulation.

The work suggested in (2) above would be of interest because stands of young development would not be expected to attain the physical parameters (such as basal area, volume, aboveground biomass) and floristic richness of older stands. As such, being able to classify the AHFR as either "young regenerating" or "old regenerating" forest would require some reasonable knowledge of these attributes. Additionally, the state of development or recovery of the forest in AHFR would be a background to interpreting the overall floristic richness.

Some previous research in AHFR have been done on a small scale, which has contributed some information. The present study was carried out in the Compartments 14 and 15 of Ayer Hitam Forest Reserve, Puchong Selangor, to obtain more data for comparative purposes as discussed above. The results from this study may also be used as an indication of ecosystem status for biodiversity conservation purposes and also support the use of this forest as a venue for teaching, research and extension activities.

In practical terms, the work was carried out to obtain the following categories of information:

The specific objectives of the study are:

i. To investigate the species composition of tree species in 5-ha plot in the Ayer Hitam Forest Reserve, and associated attributes such as spatial distribution and rate of accumulation of species with increasing area over the range 1–5 ha.

ii. To investigate other stand attributes within the 5-ha plot (including basal area, stem density, volume, above-ground biomass) that may permit comparison with those of regenerating forests and mature stands elsewhere.

Other objectives:

i. To determine the conservation status of tree species in the Ayer Hitam Forest Reserve as suggested through this study.

ii. To suggest an overall approach to continuing study of the biological richness of the Ayer Hitam Forest Reserve.

CHAPTER II

LITERATURE REVIEWS

Tropical Rain Forest in Malaysia

The tropical rain forest of Malaysia is a highly complex ecosystem, which is rich and varied in plant and animal life. In South East Asia, Malaysia is identified as one of the world's twelve mega diversity areas with extremely rich biological resources. In terms of the number and richness of species of organisms, Malaysia is ranked number four, behind China, India and Indonesia and which collectively are home to 60 – 70% of the planet's biodiversity and where endemic trees are highest (Latiff and Faridah Hanum, 1997). Malaysia, according to recent estimation has about 12,000 species and this is about 8 times more than the flora of Britain which is about two times greater in terms of area. Malaysia being a small developing country has used much of its forest area.

The flowering plants are the most abundant species in the tropical forest in Malaysia (Ismail Awang, 1993). Ng and Low (1982) has reported that about 15,000 species of flowering plants occur in Peninsular Malaysia forests of which 2,398 are tree species. These forests are home to about 300 species of mammals, 700 species of birds, 350 species of reptiles, 165 species of amphibians, 300 species of freshwater fish and 20 to 80 thousand of invertebrate species. The great majority of plant species growing wild in Malaysia are native, but some plants brought in by human agency have run